High-Pressure Calorimetry of Cryogenic Hydrocarbon Systems for Improved LNG Production

Thomas Hughes [C, S], Tauqir Syed, Kenneth Marsh and Eric May
University of Western Australia, Centre for Energy, School of Mechanical and Chemical Engineering, Crawley, Western Australia, Australia
Thomas.Hughes@uwa.edu.au

A commercial differential scanning calorimeter (DSC) has been modified to allow high-pressure heat capacity and enthalpy of fusion measurements for liquefied natural gas components and their mixtures. The first modification was the installation of a gas-filled pressure ballast vessel, which acted to buffer the pressure rise due to thermal expansion of the high-pressure cryogenic liquid sample inside the DSC over the time/temperature span of an experiment. The second modification needed to enable these measurements was the installation of heaters to control the temperature of fluid within the tubing connecting the gas ballast to the DSC's high pressure cells. By controlling the temperature profile along the tubing a temperature inversion that caused an unstable calorimetric heat flux signal was removed. Measurements of the heat capacity of liquid methane, ethane, propane and their mixtures using this modified DSC are presented at temperatures as low as 110 K and pressures as high as 5 MPa. Enthalpy of fusion measurements for hydrocarbon components that can freeze in LNG production trains are demonstrated. These data are needed to improve the predictive capabilities of equations of state used in the simulation of LNG and cryogenic gas processing plants.